Problem 1 (2 points): as the Skolkovo campus is being built, there is a need to level the hill (the elevation profile is shown below on the left) to obtain a flat surface with the elevation profile shown below on the right. Assume that the shape of each tile is square and that the cost of moving a certain amount of earth between the tiles is proportional to the Euclidean distance between the tile centers. Formulate the problem of optimal leveling strategy (determining how to move earth) as a network flow program, and then solve it using a generic LP solver (CVX). Check whether the optimal strategy you obtain is integer.

5	5	10	10	10
5	5	10	20	10
0	5	5	10	5
0	0	0	5	0

6	6	6	6	6
6	6	6	6	6
6	6	6	6	6
6	6	6	6	6

Problem 2 (4 points): implement a branch-and-bound solver for the capacitated facility location problem you were facing in the first assignment. Be careful to branch on the right variables.

Problem 3 (5 points): a group of 20 students are deciding how to fill the 10 room dormitory (the rooms are identical and each room hosts two students). Each pair of students has a certain preference on how much they would like to live together (generate a random symmetric matrix for that). You therefore want to split students into pairs in order to maximize the total preference.

- Formulate this problem as an ILP and solve it using an ILP solver (Gurobi/Mosek, etc.)
- Consider the LP relaxation, and visualize the solution. This visualization should suggest you the cuts that can tighten your relaxation. Implement the procedure that would find such cuts (the separation oracle) and run the cutting plane algorithm. Verify that you are able to get a fully integer solution when enough cuts are added into the program.
- Evaluate the performance of the generic and your own ILP solvers for larger groups of students (how well do they scale?) Consider random uniformly [0;1]-distributed matrices vs. random uniformly distributed binary matrices (student preferences are like/dislike i.e. 0 or 1).